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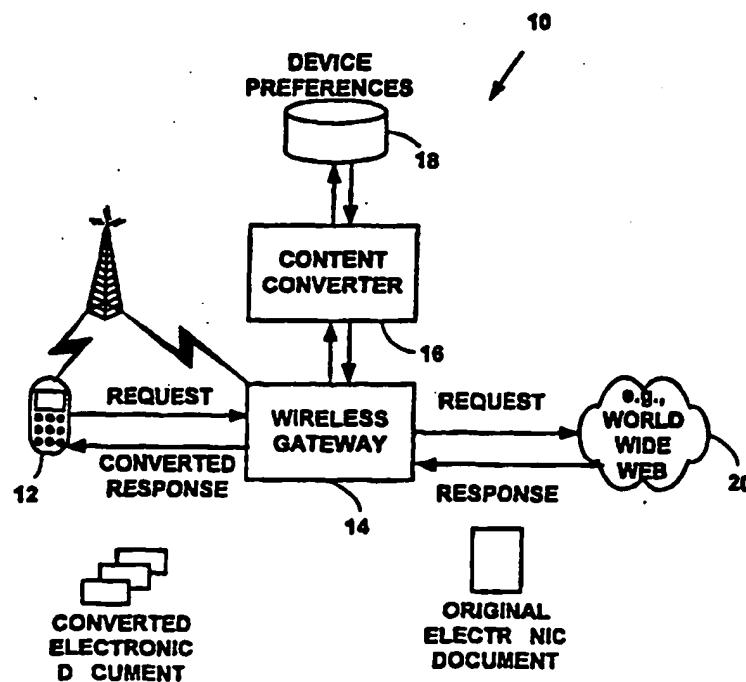
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(54) Title: CONVERTING CONTENT OF MARKUP DATA FOR WIRELESS DEVICES

(57) Abstract

A method and system for converting content of electronic data for wireless services is provided. The method and system allow a wireless device such as a wireless telephone (12) to receive electronic documents with electronic data such as web pages from the World-Wide-Web on the Internet (20) in a format suitable for display on a wireless device (12). An original electronic document in a first markup language such as Hyper Text Markup Language ("HTML") is converted (16) from a Wireless Application Protocol ("WAP"). Textual document elements and non-textual document elements (e.g., images) are converted (16) from a format suitable for the first markup language into a format suitable for the second markup language. A converted document (e.g., WML) suitable for display on a wireless device (12) is sent in response to a request for an original electronic document (e.g., HTML). Receiving a converted electronic document in response to a request for an original document may lead to greater satisfaction for users of wireless devices.



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CONVERTING CONTENT OF MARKUP DATA FOR WIRELESS DEVICES

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FIELD OF INVENTION

This invention relates to computer networks. More specifically, it relates to a method and system for converting the content of electronic data for wireless devices.

BACKGROUND OF THE INVENTION

The Internet is a world-wide network of interconnected computers. The World-Wide-Web is an information system on the Internet designed for electronic document interchange. Electronic documents on the World-Wide-Web are typically stored in files that include text, hypertext, references to graphics, animation, audio, video and other electronic data. The structure of hypertext documents is defined by document markup languages such as Standard Generalized Markup Language ("SGML"), Hyper Text Markup Language ("HTML"), Compact Hyper Text Markup Language, eXtensible Markup Language ("XML"), Virtual Reality Markup Language ("VRML"), Voice extensible Markup Language, ("VoxML") and others.

As is known in the art, a hypertext document includes markup codes called "tags." Tags define the structure of a hypertext document and typically includes at least a "begin" tag name enclosed by a delimiter and, in many instances, an "end" tag name

enclosed by a delimiter. For example, the markup tag "<H1>" signifies the beginning of a Hyper Text Markup Language first level header, and the markup tag "</H1>" signifies the end of a Hyper Text Markup Language first level header. However, the Hyper Text Markup Language image tag "" ends with the closing tag delimiter ">" and does not use an end tag in the format "". Other markup languages have similar tags used to create hypertext documents.

Markup languages allow references to additional content besides text including graphics, animation, audio, video and other electronic data. For example, the Hyper Text Markup Language allows use of graphical images in a hypertext document with an image "" tag. An exemplary Hyper Text Markup Language image tag allows a graphical logo image stored in a Joint Pictures Expert Group file "logo.jpg," to be displayed.

Hypertext documents from the World-Wide-Web are typically displayed for a user with a software application called a "browser" such as Internet Explorer, by Microsoft Corporation of Redmond Washington, Netscape Navigator, by Netscape Communications of Mountain View, California, and others. A browser typically parses a hypertext document and converts hypertext, including markup tags, into a visual display of text, graphics, animation, audio, video, etc., for display on a device such as a personal computer display.

Additional content is retrieved in a hypertext document from other sources using "hyperlink" references within hypertext documents. For example, an exemplary Hyper Text Markup Language hyperlink tag

"" provides a hyperlink to a movie file "logo.mov." When a user selects the link (e.g., with a mouse click) in a hypertext document, the movie file "logo.mov" is located using a Uniform Resource Locator ("URL") from the location "www.spyglass.com." Hyper Text Transfer Protocol (e.g., "HTTP") is used as the transfer protocol.

Transfer protocols such as Hyper Text Transfer Protocol ("HTTP"), File Transfer Protocol ("FTP"), Gopher, and others provide a means for transferring hypertext documents or additional content from other locations on the World-Wide-Web. Hyper Text Transfer Protocol is one primary protocol used to transfer information on the World-Wide-Web. Hyper Text Transfer Protocol is a protocol that allows users to connect to a server, make a hypertext request, get a response, and then disconnect from the server.

File Transfer Protocol is a protocol that provides access to files on remote systems. Using File Transfer Protocol, a user logs onto a system, searches a directory structure and downloads or uploads a file. Gopher is a protocol similar to File Transfer Protocol. Gopher provides a series of menus linked to files containing actual hypertext.

Wireless devices, such as wireless phones, now have data capabilities in addition to voice capabilities. The data capabilities allow a wireless device to receive an electronic document from the World-Wide-Web. To optimize performance, and to provide an electronic document in a format useable on wireless devices, a Wireless Application Protocol ("WAP") is typically used. The Wireless Application Protocol includes several protocols and standards designed to provide wireless devices with access to an electronic document and was developed as an alternative to other markup languages and protocols developed for the World-Wide-Web. More information on the Wireless

Application Protocol can be found on the World-Wide-Web at the URL
“<http://www.wapforum.org>.”

One component of the Wireless Application Protocol is a Wireless Markup Language (“WML”), which includes markup tags, and provides control over formatting and layout of an electronic document. The Wireless Markup Language is often more appropriate to use for wireless devices such as wireless phones than other markup languages such as Hyper Text Markup Language.

Wireless Markup Language data is structured as a collection of “cards.” A single collection of cards is referred to as a “deck.” Each card includes structured content and navigation specifications. Logically, a user of a wireless device navigates through a series of cards, reviews the content of each card, enters requested information, selects options, and navigates to and from other cards in a deck.

A user with a wireless device may request an electronic document on the World-Wide-Web. However, there are several problems associated with displaying the content of an electronic document from the World-Wide-Web on a smaller display on a wireless device.

First, most electronic documents developed for the World-Wide-Web are based on the assumption of viewing with standard “SuperVGA” resolution (e.g., 800x600 pixel resolution with 256 or more colors). A user with a wireless device, such as wireless phone, may desire to view electronic documents from the World-Wide-Web. However, most wireless devices have a display with a resolution that is less than SuperVGA (e.g., 100x200 monochrome pixel resolution) typically does not support color. In addition, a SuperVGA device is typically capable of displaying 24 lines or more of 80 character or

more of text. A wireless device display typically can display about two to five lines of 20 characters of text. Thus, the content of electronic documents will not be properly displayed and may be difficult to view based on the original hypertext content. However, an electronic document should communicate the same content to devices with a SuperVGA display as well as to the wireless devices with a smaller display that is less than SuperVGA in resolution.

One solution is to store several versions of the electronic document at a content provider site. For example, one version of the electronic document is stored in the Hyper Text Markup Language and another in the Wireless Markup Language. However, this solution requires a large amount of storage space and creates a very difficult maintenance problem to keep the various versions of the electronic document synchronized when changes are made.

Another problem is that displays on wireless devices may not be capable of displaying, or have enough memory to download and display a full page of text, graphical images, animation, video or other content included in an electronic document. Trying to display an electronic document with too much text, graphical images, animation or video may overload or otherwise adversely affect the wireless device leading to user frustration.

Yet another problem is that many users of wireless devices will not be using their wireless device for "general" browsing of the World-Wide Web. Instead, a wireless device user will typically be looking for specific information such as phone numbers, addresses, stock quotes, sports scores, current news, etc. Thus, such users may desire to have some types of electronic content from a hyper text document not displayed at all (e.g., no graphical images).

Thus, it is desirable to provide a method and system to convert an original electronic document into a converted electronic document useable in a wireless device such as a wireless phone. The method and system should allow virtually any electronic document on the World-Wide-Web to be converted and displayed in a format appropriate for a wireless device.

SUMMARY OF THE INVENTION

In accordance with preferred embodiments of the present invention, some of the problems associated with displaying electronic documents on a wireless device are overcome. A method and system for converting content of electronic documents is provided. One aspect of the invention includes a method for converting content of electronic documents. The method includes receiving a request for an original electronic document on a second network device on a first network from a first wireless device on the first network. The request includes an indication of the type of wireless device. An original electronic document for a first markup language is divided into multiple document elements including textual elements and non-textual elements for conversion into a second wireless markup language. One or more original textual elements from the original electronic document in the first markup language are converted into converted textual elements for a second wireless markup language. One or more original non-textual elements are converted from an original non-textual format for the first markup language into a converted non-textual format for the second wireless markup language. A converted electronic document is created from the converted textual elements and the converted non-textual elements based on the device type for the first wireless device from the request. The converted electronic document is sent from the second network device to the first wireless device in response to the request for the original electronic document. The present invention is not limited to wireless devices, and other network devices could also be used in place of the first wireless device.

Another aspect of the invention includes a system for content conversion. The system includes a wireless gateway for accepting requests for original electronic

documents from network devices such as wireless devices. A content converter application converts an original electronic document in a first markup language into a second converted document in a second wireless markup language suitable for display on a wireless device. A database stores conversion preferences for multiple wireless devices. The conversion preferences are used to further convert an original electronic document in a first markup language into a second converted document in a second wireless markup language suitable for display on a specific type of wireless device. However, more or fewer system components can also be used, and the present invention is not limited to the system components described. In addition, The system is not limited to wireless devices, and other network devices could also be used in place of the first wireless device.

In one exemplary preferred embodiment of the present invention, the method and system are used to allow a wireless device to request an original electronic document (e.g., a Hyper Text Markup Language document) and receive a converted electronic document (e.g., a Wireless Markup Language document) suitable for display on the wireless device. The converted electronic document suitable for display on a wireless device may provide increased satisfaction for a user of a wireless device.

For example, an original electronic document with the current weather may be requested from a wireless device. The original electronic document includes several graphical images of current weather maps and text for the current weather. The method and system may provide a converted electronic document including only the text for the current weather in a format suitable for display on the wireless device. However, the

present invention is not limited to wireless devices and other network devices could also be used.

The foregoing and other features and advantages of preferred embodiments of the present invention will be more readily apparent from the following detailed description, which proceeds with references to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the present inventions are described with reference to the following drawings, wherein:

FIG. 1 is a block diagram illustrating an exemplary content conversion system;

FIG. 2 is a flow diagram illustrating a method for content conversion;

FIG. 3 is a flow diagram illustrating a method for logical division of electronic document elements;

FIG. 4 is a block diagram visually illustrating the method for logical division of electronic document elements of FIG. 3;

FIG. 5 is a flow diagram illustrating a method for categorized division of electronic document elements;

FIG. 6 is a block diagram illustrating a portion of an exemplary Document Object Model ("DOM") for Hyper Text Markup Language;

FIG. 7 is a block diagram visually illustrating the method for categorized division of electronic document elements of FIG. 5;

FIG. 8 is a flow diagram illustrating a method for targeted conversions of electronic document elements;

FIG. 9 is block diagram visually illustrating the method for targeted conversion of electronic document elements of FIG. 8;

FIG. 10 is screen display illustrating an exemplary electronic document from the World-Wide-Web; and

FIG. 11 is a block diagram illustrating exemplary converted output from the screen display of FIG. 10 on an exemplary wireless device.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Exemplary content conversion system

FIG. 1 is a block diagram illustrating an exemplary content conversion system 10 for one preferred embodiment of the present invention. Content conversion system 10 includes multiple components. A first wireless device 12 requests original electronic documents. The first wireless device 12 includes a display that is typically less than SuperVGA resolution (i.e., less than 800x600 pixel resolution or less than 256 colors).

As is known in the art and is described above, an electronic document includes text, hypertext, graphical data or references to graphical data images, audio, video and other content. A hypertext document includes markup codes called "tags." The structure of hypertext documents is defined by document markup languages such as Standard Generalized Markup Language ("SGML"), Hyper Text Markup Language ("HTML"), compact HTML ("cHTML"), eXtensible Markup Language ("XML"), Virtual Reality Markup Language ("VRML"), and voice extensible Markup Language ("VoxML"), others. Markup languages also allow references to additional content besides text including graphics, animation, audio, video and other electronic data.

Also described above, electronic documents are typically displayed for a user with a software application called a "browser." A browser on a hand-held device or wireless device may be a sub-set of a larger browser, and may not be capable of displaying complete content of a requested electronic document as stored on an electronic document server. A browser typically reads an electronic document and renders the electronic document content into a presentation of text, graphics, animation, audio, video, etc., for

display on a device such as a personal computer. Most electronic documents developed for the World Wide Web assume that users will view the content of the electronic document with a browser on a desktop computer screen with a standard "SuperVGA" resolution (e.g., 800x600 pixel resolution with 256 or more available colors).

Returning to FIG. 1, a wireless gateway 14 services requests for electronic documents from the first wireless device 12 and sends converted electronic documents back to the first wireless device 12. A content converter application 16 converts content of an electronic document to a format usable on the first wireless device 12 (e.g., a device with a smaller display). A database 18 stores wireless device conversion preferences. FIG. 1 illustrates a single database 18. However, multiple database components can also be used. A computer network 20 provides one or more electronic document servers for supplying electronic documents.

In a preferred embodiment of the present invention, the computer network 20 is the World-Wide-Web on the Internet. As is known in the art, the Internet is a world-wide network of interconnected computers. The World-Wide-Web is an information system on the Internet designed for electronic document interchange. However, other computer networks with electronic document servers could also be used (e.g., an intranet or other Local Area Network "LAN").

FIG. 1 illustrates the content converter application 16 as an individual component. However, the content converter 16 can also be integral to the wireless gateway 14 (not illustrated in FIG. 1). A preferred embodiment of the present invention is not limited to the network components shown in the content conversion system 10 and more or fewer network components may also be used. In addition, the content conversion system 10

illustrates a first wireless device 12. In another embodiment of the present invention, the first wireless device 12 can be replaced with a wireline network device (i.e., a network device connected to a network with a temporary or permanent connection using a wire or cable). The wireline network devices would be capable of using one or more wireless markup languages (e.g., Wireless Markup Language).

In one preferred exemplary a preferred embodiment of the present invention, the wireless gateway 14 and the content converter application 16 are software components on a proxy server. However, the functionality of components from FIG. 1 can also be provided with a combination of hardware and software components, or as hardware components.

In one preferred embodiment of the present invention, the functionality of components from FIG. 1 is provided with software using object-oriented programming techniques and the C++ programming language. However, other object-oriented programming languages besides C++ could also be used. In addition, in a preferred embodiment of the present invention, the functionality of components of FIG. 1 can also be provided with non-object oriented programming languages (e.g., C programming language).

As is known in the art, object-oriented programming is used to design computer software including object-oriented objects that are easy to create, cost effective to modify, and reusable. Object-oriented objects include "object data" and "object services." Object services are provided through "object methods" (also called "object operations" or "object functions"). Object methods typically operate on private data such as "instance data" or "object state data" that an object owns. A collection of objects is

called an "object class" which is sometimes called an "object type." An object class acts as a template that describes the behavior of sets of objects. An object's implementation is typically encapsulated, and is hidden from public view. Object private instance data can only be accessed by object methods of an object class. Object public instance data is accessed through a public "object interface."

An operating environment for components of content conversion system 10 of a preferred embodiment the present invention includes a processing system with at least one high speed Central Processing Unit ("CPU") and a memory system. In accordance with the practices of persons skilled in the art of computer programming, the present invention is described below with reference to acts and symbolic representations of operations and instructions that are performed by the processing system, unless indicated otherwise. Such acts and operations are referred to as being "computer-executed" or "CPU executed." Although described with one CPU, alternatively multiple CPUs may be used for a preferred embodiment of the present invention.

The memory system may include main memory and secondary storage. The main memory is high-speed random access memory ("RAM"). Main memory can include any additional or alternative high-speed memory device or memory circuitry. Secondary storage takes the form of persistent long term storage, such as Read Only Memory ("ROM"), optical or magnetic disks, organic memory or any other volatile or non-volatile mass storage system. Those skilled in the art will recognize that the memory system can comprise a variety and/or combination of alternative components.

Acts and symbolically represented operations or instructions include the manipulation of electrical or biological signals by the CPU. The electrical or biological

signals cause transformation of data bits. The maintenance of data bits at memory locations in a memory system thereby reconfigures or otherwise alters the CPU's operation. The memory locations where data bits are maintained are physical locations that have particular electrical, magnetic, optical, or organic properties corresponding to the data bits.

The data bits may also be maintained on a computer readable medium including magnetic disks, optical disks, organic disks and any other volatile or non-volatile mass storage system readable by the CPU. The computer readable medium includes cooperating or interconnected computer readable medium, which exist exclusively on the processing system or may be distributed among multiple interconnected processing systems that may be local or remote to the processing system.

Wireless network devices and other network devices for preferred embodiments of the present invention include wireless network devices that can interact with content conversion system 10 with based on standards proposed by the Institute of Electrical and Electronic Engineers ("IEEE"), International Telecommunications Union-Telcommunication Standardization Sector ("ITU"), Internet Engineering Task Force ("IETF"), Wireless Application Protocol Forum ("WAP") Forum, or others. IEEE standards can be found on the World Wide Web at the Universal Resource Locator ("URL") "www.ieee.org." The ITU, (formerly known as the CCITT) standards can be found at the URL "www.itu.ch." IETF standards can be found at the URL "www.ietf.org." The WAP Forum standards can be found at the URL "www.wapforum.org."

Content conversion for wireless devices

FIG. 2 is flow diagram illustrating a Method 24 for content conversion. The Method 24 includes receiving a request for an original electronic document on a second network device 14 on a first network from a first wireless device 12 on the first network at Step 26. The request indicates a device type for the first wireless device 12. At Step 28, the original electronic document for a first markup language is divided into multiple document elements including textual elements and non-textual elements for conversion into a second wireless markup language. At Step 30, one or more of the original the textual elements from the original electronic document in the first markup language are converted into converted textual elements for the second wireless markup language. At Step 32, one or more of the original the non-textual elements are converted from an original non-textual format for the first markup language into a converted non-textual format for the second wireless markup language. At Step 34, a converted electronic document is created from the converted textual elements and the converted non-textual elements. At Step 36, the converted electronic document is sent from the second network 14 device to the first wireless device in response to the request for the original electronic document. However, the present invention is not limited to wireless devices and other wireline network device that are capable of using the WAP could also be used in place of the first wireless device.

In one exemplary preferred embodiment of the present invention, the content converter application 16 on the wireless gateway 14 receives the request for the original electronic document. In such an embodiment of the present invention, the content converter application 16 requests the original electronic document from the computer network 20 (e.g., the World-Wide-Web). In another embodiment of the present

invention, the content converter application 16 retrieves a copy of the original electronic document from storage (e.g., volatile or non-volatile) such as a cache, associated with the wireless gateway 14. In such an embodiment, a copy of an original electronic document is stored in storage associated with the wireless gateway 14 after a first request by the first wireless network device 12.

In one exemplary preferred embodiment of the present invention, the request received at step 26 is a Hyper Text Transfer Protocol ("HTTP") request. The request includes a device-type (e.g., in an HTTP request header) for the first wireless device 12. However, other requests can also be used (e.g., File Transfer Protocol ("FTP"), etc.).

As is known in the art, HTTP is a transfer protocol used to transfer data from an electronic document server on the World-Wide-Web. For more information on HTTP see Internet Engineering Task Force ("IETF") Request For Comments ("RFC") 2068, incorporated herein by reference.

At Step 28, the original electronic document is divided into multiple document elements including textual elements and non-textual elements for a first markup language for conversion into a second wireless markup language. In one exemplary preferred embodiment of the present invention, the first markup language is Hyper Text Markup Language ("HTML"). However, other markup languages could also be used, (e.g., XML, cHTML, SGML, VRML, VoxML, etc.). For more information on HTML see RFC-1866, incorporated herein by reference.

In one exemplary preferred embodiment of the present invention, the second wireless markup language is Wireless Markup Language ("WML") from Wireless Application Protocol ("WAP"). However, other wireless markup languages could also be

used. The WAP includes the WML as well as protocols for converting non-textual elements (e.g., images). For more information on WML see "Wireless Application Protocol Specification", by the Wireless Application Protocol Forum, April 1998, incorporated herein by reference. The Wireless Application Protocol Specification can be found at the URL "www.wapforum.org." However, other markup languages could also be used for the second wireless markup language.

In preferred embodiments of the present invention, three separate methods are used to divide or divide and convert the original electronic document into multiple textual elements and non-textual elements in the first markup language for conversion into textual elements and non-textual elements in a second wireless markup language at Step 28. However, more or fewer methods can also be used to divide the original electronic document into multiple textual and non-textual elements. The three division methods include logical division of electronic document elements, categorized division of electronic document elements, and targeted conversion of electronic document elements. The three separate division methods used at Step 28 will be explained below.

Table 1 illustrates exemplary pseudo-code for pre-processing an original electronic document received at Step 26, before it is divided at Step 28 for certain exemplary preferred embodiments of the present invention. However, the present invention is not limited to the pre-processing pseudo-code illustrated and Table 1, and other methods can be used to pre-process an original electronic document. The exemplary pseudo-code produces a token list that can be used to divide and/or divide and convert the original electronic document into a converted electronic document at Step 28.

FIG. 1

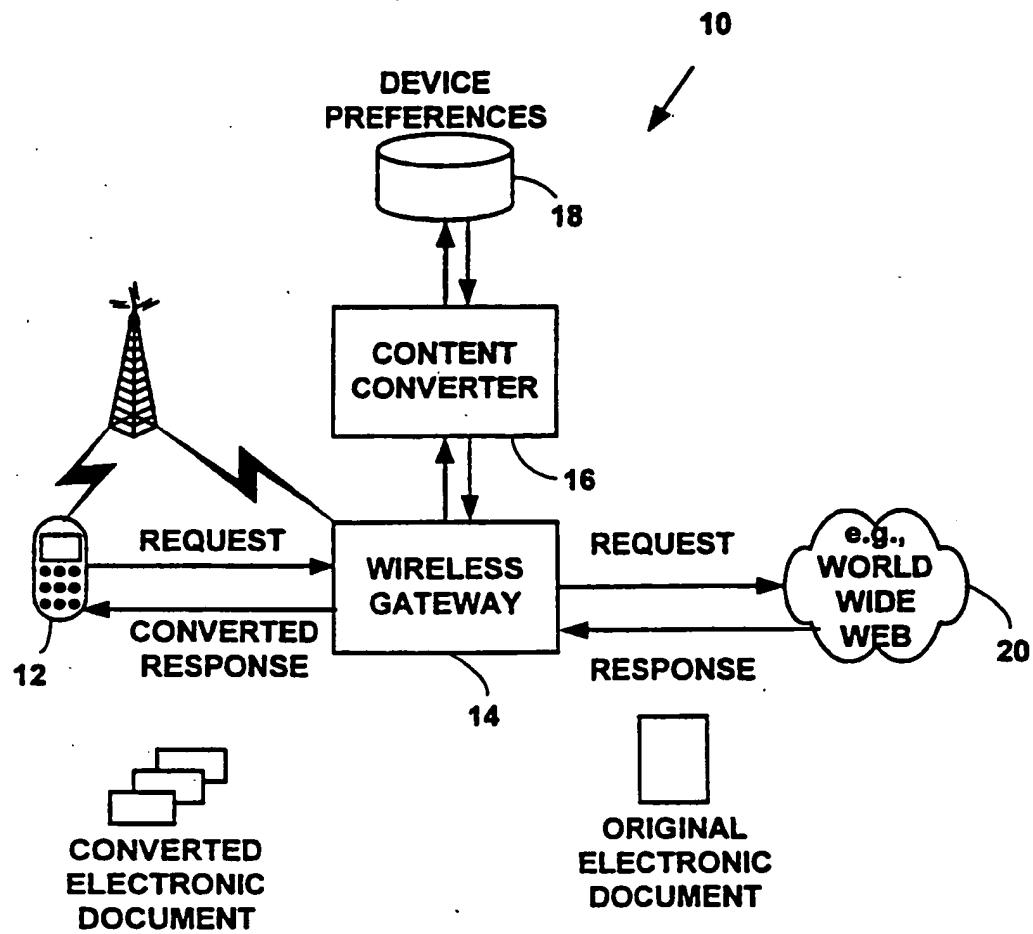
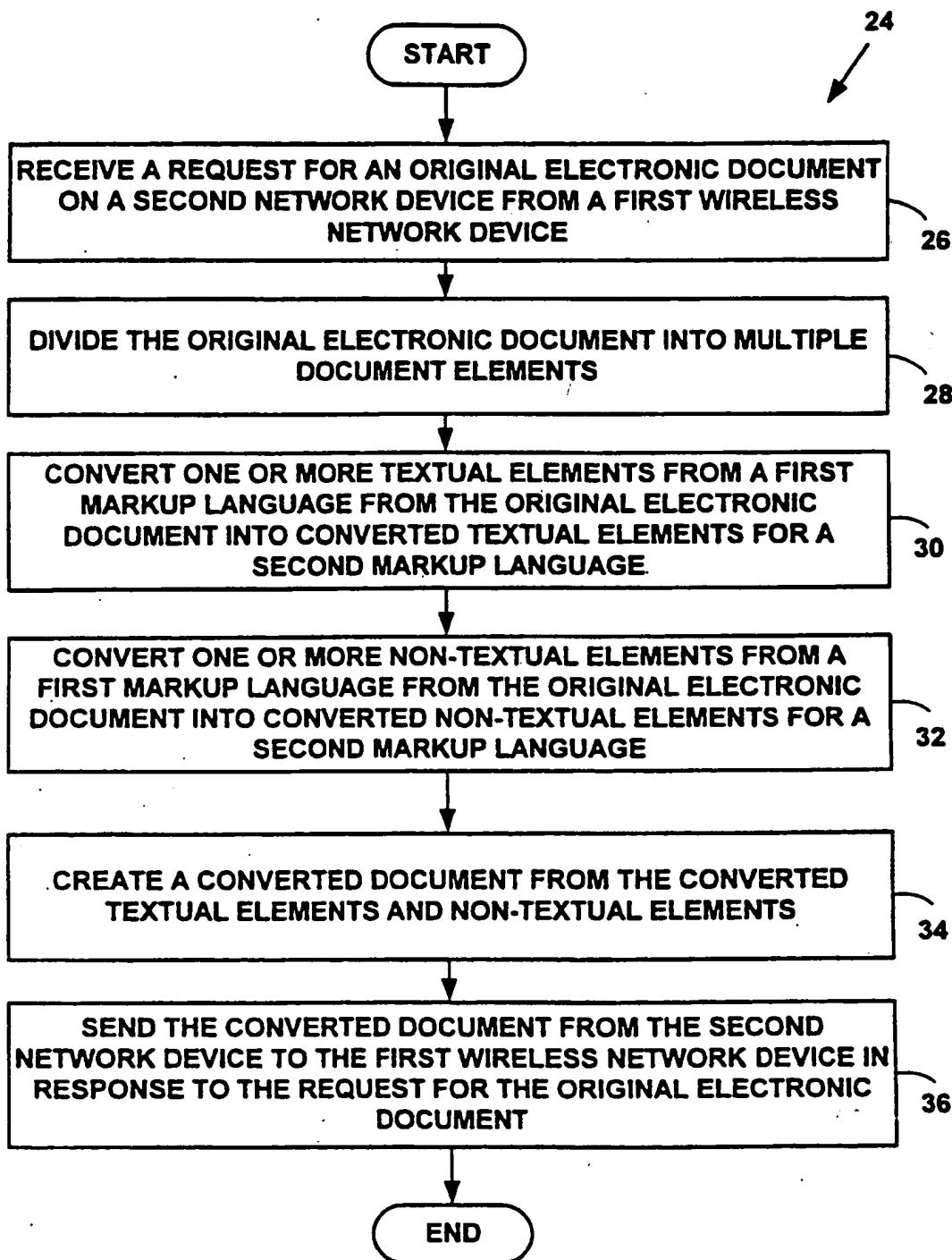


FIG. 2

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